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AUTHOR Lorton, Paul, Jr.
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ABSTRACT

EXPER-SIM (Experiment Simulation) is an instructional approach (with supporting computer programs) which allows an instructor to build a theory based model of how data would occur if an experiment were actually conducted in a world where the theory held true. The LESS version of EXPER-SIM was adapted to run on the Hewlett-Packard 2000E timesharing system in a college of business administration, and a series of data generating contexts was developed for use in an organizational theory course. The simulated contexts, which were designed to illustrate theoretical positions discussed in the course text included (1) Introductory Simulation; (2) The Individual in the Organization; (3) Leadership; (4) Managerial Grid; and (5) The Whole. The course results were positive in that students, who were using their statistics training to test hypotheses at a credible scale, were gaining a clearer idea of what theory is and how it comes about. In addition, from the responses to a course evaluation questionnaire, the students were quite positive about the course experience. The final examination simulation exercise is appended. (Author/CMV)

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SIMULATED STUDY OF ORGANIZATIONAL THEORY: THE USE OF EXPER-SIM IN THE UNDERGRADUATE BUSINESS CURRICULUM

BY

Paul Lorton

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Simulated Study of Organizational Theory: The Use of EXPER-SIM in the Undergraduate Business Curriculum

Paul Lorton, Jr.
College of Business Administration
University of San Francisco
San Francisco, California 94117
(415) 666-6771 or 666-6185

Introduction

Our knowledge of the world is tenuous at best. The more we study, the more we come to realize this. Many of us have spent considerable time learning and/or teaching probability and statistics to help us cope with the imperfect state of our understanding of the world around us. This is as true in the business world as it is in the world of physical, chemical or human behavior.

Business students, however, are especially determined to get the answer to their questions. They have little patience with the probabilistic ambiguity of the "real" world. Considerable effort is spent in giving them the statistical tools for such a world but very little time is available for them to actually assess the world with these tools. This is a special difficulty in courses dealing with organizational theory and problems.

It is not easy to provide a significant amount of data collection and analysis experience on ways in which different theoretical models can effect an organization within the confines of a one semester course. The purpose of the project described here was to provide this experience in a systematic fashion using the EXPER-SIM (Main, 1975) approach.

EXPER-SIM (Experiment Simulation) is an instructional approach (with supporting computer programs) which allows an instructor to build easily a theory based model of how data would occur if an experiment were actually conducted in a world where the theory held true. The data generated, when appropriately tested, will yield results typical of what one might find were the same study run in an unsimulated environment. The approach means data collection is a controlled, predictable process and the educationally important phases of hypothesis formulation and statistical interpretation can receive the student's and instructor's main attention.

Organizational Theory (BA 192a) and Organizational Problems (BA 192b) form a year long sequence of courses required of seniors in the College of Business Administration. Typically, three sections of about fifty students each take BA 192a in the fall semester and another single section of fifty students takes it in the spring. BA 192a meets for three hours of lecture per week with little integrated laboratory experience.

At this point, BA 192a and BA 192b tend to be discrete. The first course presents, in a variety of ways, theories of organizational behavior. In the second course (BA 192b), general problems of business are discussed often using cases and/or a management decision game played on a computer.

Using the EXPER-SIM approach, the emphasis in the Organizational Theory course could be on hypothesis testing. A set of experiences illustrating the process of experimentation and finding answers from a simulated world were developed. In general, the simulations concentrated on three contexts or problem areas: managerial style, worker incentive variants, and organizational structure.

With the EXPER-SIM capability, the students were able to experiment and actually develop testable hypotheses from which they could infer theories making the whole theory building process open to their experience.

The main reason for adapting EXPER-SIM to the Organizational Theory course was the same as the central purpose of EXPER-SIM itself. We wanted the experience in this course to give the students a fundamental familiarity with the design and evaluation of research. We feel that it is necessary to give the students a practical appreciation of organizational theories—that is, the student should be intimately aware of the process by which theories are developed. Too often, students read the theories of organizational behavior as fact—the use of EXPER-SIM in this course helped them appreciate theories as tentative summaries of tested hypotheses.

Ordinarily the Organizational Theory course is a lecture-text book course. Some attempts have been made to have the students experience hypothesis testing in this area first hand. Toward the end of the semester the students participate in a sequence of activities designed to let them study organizations first hand by being participant-observers. It is a popular element of the course but seldom produces testable data.

Trying to collect data about organizations from the "real world" has proven to be a difficult process which detracts from the purpose of the exercise because the focus of the effort quickly becomes data collection. Even with some data collected, there was often too little available for reliable illustration of the rest of the process. The use of the EXPER-SIM approach was intended to correct this situation.

Design of the Project

During the spring, 1976, the LESS version (see Thurmond and Cromer, 1975a, 1975b) of EXPER-SIM was adapted to run on the Hewlett-Packard 2000E timesharing system in the College of Business Administration. A series of data generating contexts was developed for use in the Organizational Theory course. These contexts were designed to illustrate various theoretical positions discussed in the text for the course (Bobbit, et. al., 1974).

Five simulation contexts were used in all:

1. *Introductory Simulation.*

The purpose of this simulation was to introduce the whole process of simulating organizational behavior to the students. They could select various values for five variables. The relevant variables for this particular simulation were noise and lighting levels. Their effect was built to illustrate, in a very clean and emphatic fashion, the "Hawthorne" effect—whenever levels of these two variables were changed, productivity (one of the two possible dependent variables) went up.

2. *Simulation I: The Individual in the Organization.*

The second simulation was designed to illustrate the theoretical effect of various management initiated programs on job satisfaction for supervisors in a manufacturing environment. A variety of theories reported in the text discussion (see Bobbit, et. al., 1974, Chapter Four) of the individual in the organization were used. The results students achieved depended on what they selected to vary from the six possible factors, and whether they looked at scores of "satisfaction" or "dissatisfaction" as the dependent variable.

3. *Simulation II: Leadership*

The third simulation in the series was built on Fiedler's theory of leadership (Fiedler, 1967). This simulation was designed to reproduce the effects theorized by Fiedler in a fairly straight forward fashion.

```
GET-SEX.F
RUN

THIS SIMULATION WILL PRODUCE DATA FOR
EXPLORING THE WHOLE OPERATION ON A
FIRM AS PROGRAMS FOR VARIOUS DEPART-
MENTS ARE MODIFIED. (THE CURRENT STATE
IS NO TRAINING, NO COMPENSATION PLAN,
MIXED DECISIONS AND MIXED SCHEDULE. TO
GET A BASELINE RUN WITH THESE CONDI-
TIONS.)
```

DO YOU WISH INSTRUCTIONS (Y OR N) ?Y
INSTRUCTIONS:

THIS SIMULATION PRODUCES THE EFFECT OF VARIOUS PROGRAMS IMPLEMENTED IN VARIOUS DEPARTMENTS ON INDICES REFLECTING THE OPERATION OF THE BUSINESS AS A WHOLE. YOU CAN SELECT A VARIETY OF COMBINATIONS. IN EACH SIMULATION YOU WILL SEE THE EFFECT OF YOUR MANIPULATION ON PRODUCTIVITY, SALES, PROFIT AND NEW PRODUCTS AND DEVELOPMENTS

THE FOLLOWING ARE THE VARIABLES AND VALUES:

VARIABLE	VALUE
DEPARTMENT	PRODUCTION / SALES / ACCOUNTING OR RESEARCH
TRAINING	PEOPLE / PRODUCTION / NONE (LOW, MEDIUM OR HIGH LEVELS)
COMPENSATION	MORE, LESS, OR NO LINK TO PROFIT, SALES OR PRODUCTION
DECISIONS	CENTRALIZED / DECENTRALIZED / MIXED
SCHEDULE	UNSTRUCTURED / STRUCTURED / MIXED

INPUT VALUES FOR THIS RUN

DEPARTMENT	?P
TRAINING PROGRAM	?N
COMPENSATION	?N
DECISIONS	?M
SCHEDULE	?M

Figure 1. Instructions and Sample Input for Final Simulation.

4. *Simulation III: Managerial Grid*

This simulation was built in the context of the Managerial Grid (Blake & Mouton, 1964). It followed closely the form of the simulation above illustrating leadership style.

5. *Final Simulation: The Whole*

As part of an out-of-class final examination exercise, the students were assigned a very global simulation problem. The instructions for this assignment are appended. The actual simulation context was quite global. The main purpose of the assignment was to present a fairly complex situation that no one student could even begin to exhaust. A summary of the instructions for the context is also included in the Appendix.

The student signed onto the HP 2000E system and ran the appropriate program. Each simulation was designed to give the student all the information he needed to generate data. Interpretation depended on referring to the text and other students. Figure 1 is a sample of the instructions from the final simulation.

FINAL SIMULATION EXPERIMENTAL RUN NUMBER 1
CONDITIONS:

DEPARTMENT	= P
TRAINING	= N
COMPENSATION	= N
DECISIONS	= M
SCHEDULE	= M

(IN DOLLARS)

Week	*Units Prod*	*Sales*	*Profit*	*Units Develop*
1	119	168	61	43
2	132	173	73	42
3	118	131	50	39
4	141	185	75	38
5	162	176	81	32
6	139	174	79	32
7	142	149	71	35
8	123	129	67	23
9	125	170	77	27
10	135	182	65	26
11	135	137	76	33
12	161	125	56	41

Figure 2. Sample Run #1 of Final Simulation

After reading the instructions, the student selected the values for the variables he wanted to study. Figures 2, 3, and 4 show the results of varying training given in the production department. While engaged in one experiment, the program "remembered" what had happened before to allow for Hawthorne and other non-reversible experimental effects.

The students participating in this study were enrolled in one section of the Organizational Theory course during the fall semester, 1976. The students were assigned to run the simulation at approximately three-week intervals throughout the semester. They were

encouraged to form small groups of two or three while running these simulations in order to facilitate informal discussion of which hypotheses to formulate and test.

FINAL SIMULATION EXPERIMENTAL RUN NUMBER 2
CONDITIONS:

DEPARTMENT		= P
TRAINING	= PE	LEVEL : H
COMPENSATION		= N
DECISIONS		= M
SCHEDULE		= M

(IN DOLLARS)

Week	*Units Prod*	*Sales*	*Profit*	*Units Develop*
1	125	169	64	44
2	139	174	72	42
3	126	132	51	42
4	153	184	78	38
5	164	176	84	34
6	146	176	82	31
7	144	152	73	37
8	131	130	68	26
9	131	171	77	26
10	147	181	68	25
11	137	138	78	32
12	162	127	58	42

Figure 3. Sample Run #2 of Final Simulation

FINAL SIMULATION EXPERIMENTAL RUN NUMBER 3
CONDITIONS:

DEPARTMENT		= P
TRAINING	= PR	LEVEL : H
COMPENSATION		= N
DECISIONS		= M
SCHEDULE		= M

(IN DOLLARS)

Week	*Units Prod*	*Sales*	*Profit*	*Units Develop*
1	142	169	64	46
2	152	175	73	43
3	140	130	54	41
4	157	183	80	39
5	170	175	86	36
6	164	176	80	30
7	144	154	75	40
8	140	130	70	29
9	138	169	78	29
10	154	182	70	25
11	152	140	78	32
12	177	130	58	45

Figure 4. Sample Run #3 of Final Simulation

For this report, the data collected consist mainly of responses to a questionnaire each student completed as he turned in his final work. Responses from about three-quarters of the class were analyzed for this report (the rest of the responses will be available too late to be included here).

Results

During the course of the semester the students ran five simulations. A lot of class time was spent on the first three—discussing the appropriate statistical design and analysis, the range of possible findings, and actual findings of various members of the class. The fourth simulation was not discussed as fully but was used to reinforce the idea of building conclusions from the findings of a number of people. This was part of the required activity in the final simulation.

The students were then asked to rate each of these simulations at the end of the semester on the following scale:

0 Can't evaluate
1 Worthless
2 Marginal
3 OK
4 Good
5 Excellent

Table 1 lists the percentages responding in each category and the mean response to each item.

The students were also asked to rate three other aspects of the course: the text, the final exam activity, and the group activity described above. Table 2 gives a summary of responses to these items.

Finally a series of yes/no questions was asked to assess the role the simulation played in the course in general. The questions were:

1. Do you feel the simulations contributed to your appreciation of earlier courses?
2. Do you feel the simulations were valuable?
3. Do you feel the simulations were used appropriately?
4. Do you feel the simulations helped you evaluate the group project?

Table 1. Percentage Responding in Each Category and Mean Response in Rating Five Simulation Activities.

	Rating					
	1	*2*	*3*	*4*	*5*	*Mean*
1. Sample Simulation	4.7	9.5	23.8	47.6	14.2	3.57
2. Simulation I	4.7	9.5	33.3	38.0	14.2	3.47
3. Simulation II	5.0	10.0	30.0	35.0	20.0	3.55
4. Simulation III	13.6	9.0	36.3	31.8	9.0	3.13
5. Final Simulation	5.0	5.0	25.0	25.0	20.0	3.50

Table 2. Percentage Responding in Each Category and Mean Response in Rating Non-Simulation Components of the Course.

	Rating					
	1	*2*	*3*	*4*	*5*	*Mean*
Textbook	9.0	9.0	27.2	50.0	4.5	3.32
Final Exam	0.0	4.7	38.0	42.8	14.2	3.67
Group Activity	0.0	4.7	33.3	23.8	38.0	3.95

Table 3 gives the percentage responding yes/no to each of these questions.

Table 3. Percentage Responding Yes/No to Four Questions

	Yes	*No*
Question 1.	71.5	28.5
Question 2.	80.9	19.1
Question 3.	80.9	19.1
Question 4.	66.7	33.3

Discussion

The results of this effort are quite rewarding. One can see two things very clearly: (1) the students are using their statistics training to test hypothesis and, after considerable review, are actually doing a credible job, and (2) the students are gaining a clearer idea of what a theory is and how it comes about. In addition, from the responses to the questions presented above, the students were quite positive about the experience.

To see students actively and intensely engaged in collecting data, analyzing the data, and exchanging conclusions is most rewarding. Some students actually realize this, see the purpose of the exercise, and are quite involved. Other students don't see the point and go through the exercise as an exercise.

This latter type is troublesome. One can see that they are profiting and learning from the experience, but they are still looking for definitive answers and not for methods for finding answers.

Part of the problem and part of the eventual solution for these students, is to introduce them to the tentative nature of the world and statistic's role in that world in their freshman statistics course. Perhaps they spend too much time doing the problems in the back of the chapters in the statistics book and too little time getting data from the real world where things don't always come out even (or worse yet—a perfect square).

One interesting incident in the course of the project was the necessity for devoting the better part of four class periods to a review of statistics. All the students in the course had completed the four semester quantitative methods sequence required by the College. This sequence included two semesters of statistics and a substantial amount of probability in a third course.

The students seemed to have a tolerable grasp on the mechanics of various statistical techniques—that is, they could take two groups of independent numbers and produce a value for a Student's *t*. Since programs available for easy use on the computer did the mechanics of the analysis, this computational skill was not needed or used. The needed skill was in design and interpretation. Forming a testable hypothesis and testing it with the computer doing the analysis were the needed skills.

The experience was well worth it and the results are compellingly positive. The use of EXPER-SIM as a system for devising data-generating contexts is quite useful in many business college settings. The technique will be used in other courses.

Certainly the later stages of the introductory statistics course can benefit from the use of EXPER-SIM. Marketing research, managerial psychology, and even operations management are all courses for which EXPER-SIM applications will be developed.

Appendix

Final Simulation: Instructions

You will be given the specifications for the final simulation. For this final simulation you are to do the following tasks:

1. Test a particular hypothesis which seems interesting to you.
2. Write a brief summary of your hypothesis and findings.
3. Exchange the above with other investigators. Be sure to demand quality for quality—that is don't give a nicely typed document in exchange for something written on the bottom of a Dixie Cup.

This should result naturally in the following report of three to five pages:

1. Introduction to the aspect of the situation you explored (half a page or so).
2. Statement of your hypothesis indicating the theory or theories to which it is related (half a page or so).
3. Statement and interpretation of your results (about one page).
4. Statement of the results of other investigators and how they relate to yours. (Bonus points awarded for each "other investigator" cited.) (Variable length depending on how many you get.)
5. Brief summary, conclusion and suggestions for further work developing out of sections one through four above. (A paragraph or so of each summary, conclusion, suggestion.)

You may do this in groups of no more than THREE (3). If the group size is more than ONE (1), the report MUST be typed and turned in clearly indicating the members of the group who participated. It can be turned in apart from the final but you are best off by turning in all finals and the report at the same time.

Final Simulation

You are in charge of an organization. You have complete control of what the organization does. While this sounds ideal and unrealistic, it is not since your real control is limited to doing some very global things and evaluating their effect on some rather broad indices. Essentially you have several departments and a series of indices you are watching.

The departments are:
- Production
- Sales and Marketing
- Accounting and Finance
- Research and Development

The indices you are watching include:
- Productivity
- Sales
- Profit
- New Products and Developments

For each run of the simulation you can implement a program in a department and watch its effect over 12 weeks on each of the indices. The programs you can implement are:

Training Supervisors. You can implement programs which will make supervisors in any of the departments low, medium or high on concern for production or concern for people.

Modification of Compensation Plan. You can make compensation linked more or less directly to profit, sales or production.

Modification of Decision Making Locus. You can make decision making highly centralized, highly decentralized or mixed within any of the departments.

Modification of Work Schedule. Working hours can be made unstructured, highly

structured or systematically flexible (a function of quotas, etc.) in any of the departments.

The final question for you is how to improve the organization's operation. What improvement consists of is up to you to define. What specific area you choose is also up to you. Focus on one aspect and explore an effect of one program. Depend on others to attack other areas (coordinating your efforts with them for best results).

Acknowledgment

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